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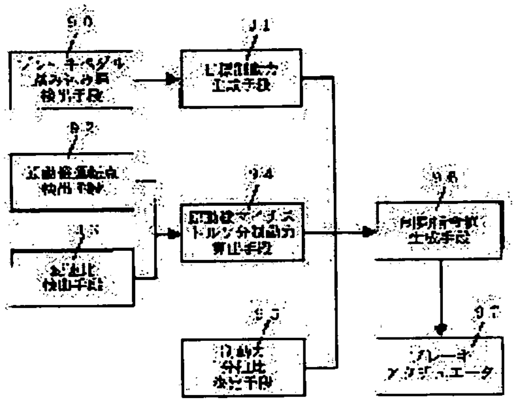
## (54) BRAKING FORCE CONTROL DEVICE FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To generate braking force at the same slip factor in all wheel so as to improve braking performance by generating target braking force from the depression quantity of a brake pedal, obtaining a braking force allotment ratio of the driving wheel side and non-driving wheel side, and braking a corresponding wheel according to the control proportional value.

SOLUTION: Target braking force is generated by a target braking force generating means 91 from the depression quantity of a brake pedal detected by a brake pedal depression quantity detection means 90, and an operating point is obtained by a prime mover operating point detecting means 92. A change gear ratio is detected by a change gear ratio detecting means 93, and braking force by minus torque is obtained by a prime mover minus torque portion braking force computing means 94. The ratio of braking force allotted to a driving wheel and a non-driving wheel is determined by a braking force allotment ratio determining means 95, and the braking command value of the driving wheel and non-driving wheel is obtained by a braking command value genrating means 96 form the target braking force, braking force allotment ratio and prime mover minus torque portion braking force. According to this, a corresponding brake actuator 97 is actuated.



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## CLAIMS

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[Claim(s)]
[Claim 1] Braking force-control equipment for vehicles characterized by providing the following. An amount detection means of brake-pedal treading in to detect the amount of treading in of a brake pedal A target damping force generation means to generate target damping force from the amount of treading in of a brake pedal A prime-mover operating-point detection means to search for the operating point of a prime mover A change-gear-ratio detection means to detect the change gear ratio of a change gear, and a prime-mover minus torque part damping force calculation means to ask for the damping force by the side of the driving wheel by the minus torque of a prime mover, A damping force assignment ratio determination means to determine the rate of the damping force which each by the side of a driving wheel and a non-driving wheel shares from the service condition of vehicles, The brake actuator which makes a braking instruction value generation means to calculate the braking instruction value by the side of a driving wheel, and the braking instruction value by the side of a non-driving wheel, and the wheel which corresponds according to the braking instruction value generate damping force from the aforementioned target damping force, a damping force assignment ratio, and prime-mover minus torque part damping force
[Claim 2] Braking force-control equipment for vehicles according to claim 1 to which equip with a target prime-mover minus torque generation means to generate the desired value of prime-mover minus torque part damping force from the service condition of vehicles, and it was made to change the change gear ratio of a change gear according to the desired value.
[Claim 3] A damping force assignment ratio determination means is braking force-control equipment for vehicles according to claim 1 or 2 which determines a damping force assignment ratio using the map information acquired from a navigation means.
[Claim 4] A damping force assignment ratio determination means is braking force-control equipment for vehicles according to claim 1 or 2 which determines a damping force assignment ratio according to the signal from a weather state detection means.
[Claim 5] A damping force assignment ratio determination means is braking force-control equipment for vehicles according to claim 1 or 2 which determines a damping force assignment ratio according to the signal from a vehicles weight detection means.
[Claim 6] A vehicles weight detection means is braking force-control equipment [ equipped with a weight-distribution detection means to detect a weight distribution based on taking a seat of crew ] for vehicles according to claim 5.
[Claim 7] Braking force-control equipment for vehicles of any one publication of the claim 1-6 using the engine as a prime mover.
[Claim 8] Braking force-control equipment for vehicles of any one publication of the claim 1-6 using the motor as a prime mover.
[Claim 9] Braking force-control equipment for vehicles according to claim 8 made to generate prime-mover minus torque part damping force by energy regeneration of a motor.
[Claim 10] It is braking force-control equipment for vehicles of any one publication of the claim 1-9 with which it has a brake actuator for every wheel, and a braking instruction value generation means calculates a braking instruction value for every wheel.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention is [0002] which is the thing to which suitable braking is made to perform with the damping force obtained because a prime mover generates minus torque in detail, and the damping force which can generate a brake system about the equipment which controls the damping force for vehicles.
[Description of the Prior Art] As a Prior art, there is a brake operating unit shown, for example in drawing 18 (references, such as JP,63-13377,U).
[0003] An engine brake operation detection means 103 by which this detects the operation of the driving wheel 102 which power is delivered from an engine 101, and the engine brake in this drive system, The non-driving wheel 104 rolled according to movement of vehicles, and a brake means 105 to give damping force to this non-driving wheel 104, It has the actuator 106 which operates this brake means 105, and the control means 107 which operate the aforementioned actuator 106 that damping force should be given at the non-driving wheel 104 at the time of the engine brake operation detection by the aforementioned engine brake operation detection means 103.
[0004] In this brake operating unit, when the engine brake operation detection means 103 detects the operation of engine brake, and the brake means 105 gives damping force equivalent to engine brake to the non-driving wheel 104 side, they are a slowdown or a thing of making it stop in the state where vehicles were stabilized.
[0005]
[Problem(s) to be Solved by the Invention] However, conventionally, since equipment brakes apart from such a usual brake, therefore becomes the usual brake and double composition, composition becomes complicated and it has the fault that cost goes up.
[0006] Moreover, even if operational status, a vehicles state, and circumference [ vehicles ] environment change, damping force can be given only in the same state, but there is a trouble of being hard to perform optimal braking.
[0007] This invention aims at solving such a trouble.
[0008]
[Means for Solving the Problem] An amount detection means 90 of brake-pedal treading in by which the 1st invention detects the amount of treading in of a brake pedal as shown in drawing 19 , A target damping force generation means 91 to generate target damping force from the amount of treading in of a brake pedal, A prime-mover operating-point detection means 92 to search for the operating point of a prime mover, and a change-gear-ratio detection means 93 to detect the change gear ratio of a change gear, A prime-mover minus torque part damping force calculation means 94 to ask for the damping force by the side of the driving wheel by the minus torque of a prime mover, A damping force assignment ratio determination means 95 to determine the rate of the damping force which each by the side of a driving wheel and a non-driving wheel shares from the service condition of vehicles, It has a braking instruction value generation means 96 to calculate the braking instruction value by the side of a driving wheel, and the braking instruction value by the side of a non-driving wheel, and the brake actuator 97 which makes the wheel which corresponds according to the braking instruction value generate damping force from the aforementioned target damping force, a damping force assignment ratio, and prime-mover minus torque part damping force.
[0009] The 2nd invention is equipped with a target prime-mover minus torque generation means to generate the desired value of prime-mover minus torque part damping force from the service condition of vehicles, and it was made to change the change gear ratio of a change gear in the 1st invention according to the desired value.
[0010] The 3rd invention determines a damping force assignment ratio in the 1st or 2nd invention using the map information from which a damping force assignment ratio determination means is acquired from a navigation means.
[0011] In the 4th invention, in the 1st or 2nd invention, a damping force assignment ratio determination means determines a damping force assignment ratio according to the signal from a weather state detection means.

[0012] In the 5th invention, in the 1st or 2nd invention, a damping force assignment ratio determination means determines a damping force assignment ratio according to the signal from a vehicles weight detection means.

[0013] The 6th invention is equipped with a weight-distribution detection means by which a vehicles weight detection means detects a weight distribution based on taking a seat of crew, in the 5th invention.

[0014] The 7th invention used the engine as a prime mover in the 1st - the 6th invention.

[0015] Invention of the octavus used the motor as a prime mover in the 1st - the 6th invention.

[0016] The 9th invention generates prime-mover minus torque part damping force by energy regeneration of a motor in invention of the octavus.

[0017] The 10th invention is equipped with a brake actuator for every wheel in the 1st - the 9th invention, and a braking instruction value generation means calculates a braking instruction value for every wheel.

[0018]

[Effect of the Invention] Although according to the 1st invention braking by the brake actuator will be performed if it gets into a brake pedal, and braking by the side of the driving wheel by minus torque will be performed if the operating point of a prime mover is on a minus torque side Based on the damping force assignment ratio by the side of the driving wheel determined from the amount of treading in of the brake pedal, the damping force by the side of the driving wheel by the minus torque of a prime mover, and the service condition of vehicles, and a non-driving wheel, the control-command value by the side of a driving wheel and a non-driving wheel is calculated, and the corresponding brake actuator operates.

[0019] Therefore, to change of the service condition of vehicles, such as a road grade and a vehicles weight distribution, a suitable damping force assignment ratio can be obtained, damping force can be generated in the same slip ratio with all wheels, vehicles can be slowed down and stopped in the stable and optimal state, and the braking performance which vehicles have can be demonstrated to the maximum extent. Moreover, by not making it the usual brake and double composition, since ** is also good, structure simplifies and cost decreases.

[0020] According to the 2nd invention, it is easy to slide on a road surface, and when the damping force by the side of the driving wheel by the minus torque of a prime mover is too large, the damping force can be made to share with a non-driving wheel side, and the stable slowdown can be secured.

[0021] According to the 3rd invention, a passage situation can be grasped from a navigation means and the suitable damping force assignment ratio by the road grade can be decided.

[0022] According to the 4th invention, from a weather state, it can grasp that fine, rain, snow, etc. have possibility of being easy to slide on a road surface and that the road surface has frozen etc., and it can brake by deciding a damping force assignment ratio based on these, without producing a slip.

[0023] According to the 5th and the 6th invention, a vehicles weight distribution can be grasped exactly and a suitable damping force assignment ratio can be obtained.

[0024] According to the 7th invention, the braking performance of an engine automobile can be improved.

[0025] According to invention of the octavus, the braking performance of an electric vehicle can be improved.

[0026] According to the 9th invention, it becomes energy saving in order to revive the energy of braking.

[0027] According to the 10th invention, braking of each wheel is independently controllable.

[0028]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing.

[0029] The whole structure of a system is shown in drawing 1 . The dashed line expresses electric system and the solid line expresses relation of a fluid-pressure system. Moreover, drawing 1 expresses the rear drive vehicle.

[0030] In this system, in order to make the same a usual brake and a usual feeling of operation, it has the brake pedal 40 and booster 41 which are made to generate a pressure, and a master cylinder 42. Master cylinder ** is detected by the pressure sensor 43, the amount of treading in of a brake pedal 40 is detected by the stroke sensor 44, respectively, and a brake controller 34 HE input is carried out. Furthermore, the brake controller 34 HE input of the traffic information from a navigation system 35 etc. is carried out, and decelerating desired value is generated by the brake controller 34.

[0031] The input rotational frequency and output rotational frequency the parameter showing the operational status of engines, such as an engine speed of the engine 32 controlled by the engine controller 36 and the throttle opening TVO, on the other hand, indicates the state of a change gear 33 to be through the engine controller 36 are changed into a change gear ratio by the change gear controller 37, and are inputted as brake controller 34 HE. Based on these measurement results, the damping force by the side of the driving wheel 47 by engine brake and 48 (in the case of a rear drive vehicle) is called for, and the pressure-control desired value of the brake actuators 50-53 currently installed in each wheels 45-48 is calculated together with previous decelerating desired value.

[0032] The wheel speed sensor for detecting the pressure sensors 54-57 for detecting the brake actuators 50-53 for making each wheels 45-48 of floor line, FR, RR, and RL generate the damping force of the brake currently installed in each wheels 45-48 and each brake pressure force and each wheel speed is installed, and it connects with the brake controller 34 electrically.

[0033] Next, an engine 32, a change gear 33, and the detailed example of composition of a brake system are described.

[0034] A thing as shown in drawing 2 as one example is used as a power mechanism which consists of an engine 32 and a change gear 33.

[0035] As for an engine 32 side, the hot-wire formula air flow rate sensor of 1 measures the inflow air content to an inlet pipe first. A throttle valve 2 plays the role which adjusts the air content to supply, and drives it by throttle bitter taste CHUE 1 TA 3. This amount of operation is usually determined with the accelerator pedal and a certain functional relation outside drawing. The air supplied through the throttle valve 2 passes an intake manifold 4, and attains it to an inlet pipe 6. Here, an injector 5 injects fuel based on the instructions from the engine controller (ECU) 36, and a gaseous mixture is obtained. This gaseous mixture flows into a combustion chamber 10, while the inlet valve 13 is open.

[0036] And a gaseous mixture is lit with an ignition plug 15 at a ****** moment, depresses a piston by the explosive power, rotates the crankshaft outside drawing through a connecting rod 12, and generates an engine torque. An exhaust valve 14 opens the exhaust gas after combustion, and when a piston 11 goes up, it is discharged to an exhaust pipe 7. The oxygen density in exhaust gas is measured by O2 sensor 16, and is used for control of the fuel quantity injected from an injector 5. 8 is a cylinder block and 9 is the cylinder head.

[0037] As a throttle actuator 3, a step motor etc. is used, for example and it is controlled by the engine controller 36. Information, such as an inflow air content, an oxygen density, the degree of crank angle, the vehicle speed VSP, the amount of accelerator treading in, and the throttle opening TVO, is inputted into the engine controller 36, and ignition timing of an engine, fuel oil consumption, throttle opening, etc. are controlled based on these information.

[0038] As a change gear 33, the toroidal type nonstep variable speed gear is used, for example. 21 (a) is an input disk and an engine output torque is inputted through the torque converter outside drawing, and a loading cam. An input torque **** the power roller 22, the output disk outside drawing, a reduction gear, a final gear, etc., and serves as driving force. A change gear ratio is controlled by making a trunnion 23 **** and changing the radius ratio of the point of contact by the side of the input disk 21 of the power roller 22, and the point of contact by the side of an output disk. In order to carry out **** movement of the power roller 22, the minute variation rate of this power roller 22 is made to carry out in the vertical direction from a criteria position using the oil pressure piston 24, the lateral force is generated by changing the direction of the rotation vector in the point of contact of the input disk 21 and the power roller 22, and **** movement is made to perform. The variation rate of this oil pressure piston 24 is performed by the plisse scum 25 which feeds back the amount of displacement of the actuator 27 driven based on the instruction value from the change gear controller (CVT controller) 37, a sleeve 28, the oil pressure room 24 (a), the oil pressure piston 24 that consists of 24 (b), and this oil pressure piston 24, and ****** of the aforementioned power roller 22, a link 26, and the hydraulic servomechanism which consists of spools 29. Based on information, such as an engine speed inputted, a turbine rotational frequency (input rotational frequency of a change gear) of a torque converter, the vehicle speed VSP, and the throttle opening TVO, with reference to the change-gear-ratio map defined beforehand, the change gear controller 37 computes the target change gear ratio of an instant instant, and drives an actuator 27.

[0039] all the performance maps of the engine in which the operating point of an engine makes a parameter throttle opening TVO as shown in drawing 3 , and the relation between an engine speed and an engine output torque is shown -- reaching -- etc. -- it asks from a horsepower curvilinear map In order to move an operating point, it is realizable by changing the throttle opening TVO of an engine, or changing a change gear ratio, and changing an engine speed (here, the vehicle speed assumes that it is a thing in a certain short **** which hardly changes).

[0040] In addition, in the example mentioned later, an engine output torque is in a negative state, and is changing the strength of engine brake by changing a change gear ratio (as a change gear, the nonstep variable speed gear into which a change gear ratio is freely changeable is used).

[0041] Moreover, the property of the torque converter outside drawing is expressed by the performance curve shown in drawing 4 . If the velocity ratio which is a ratio of input-shaft rotational speed and output-shaft rotational speed is calculated from this drawing when the lock-up clutch of a torque converter is off (non-lock-up), a torque converter output torque will be called for from the engine output torque obtained from all engine performance maps.

[0042] The velocity ratio of a torque converter, a torque ratio, efficiency, and torque capacity are calculated from the following formula.

[0043]

Velocity ratio = output-shaft rotational speed / input-shaft rotational speed -- (1)
Torque ratio = output-shaft torque / input-shaft torque -- (2)
Efficiency = output-shaft horsepower / input-shaft horsepower -- (3)
Torque capacity = torque required to rotate an input shaft / (input-shaft rotational speed) 2 -- (4)

As brake actuators 50-53, what is shown in drawing 5 is used, for example.

[0044] The brakes operation section 38 compresses brake fluid in response to the booster 41 which amplifies the treading strength which joins the brake pedal 40 which an operator operates on foot, and a pedal 40, and the amplified treading strength, and consists of master cylinders 42 made to generate brake pressure. The master cylinder pressure sensor 43 detects the pressure (M/C **) of a master cylinder 42. The fluid-pressure piping 60 shown as the solid line draws brake fluid, and transmits a pressure. A wheel cylinder 61 brakes a disk in response to the brake pressure generated with the master cylinder 42.

[0045] The cut valve 62 intercepts between a master cylinder 42 and the control cylinders 63 by electric operation, causes the role which confines a fluid pressure in the control cylinder 63 side, and consists of solenoid-coil 62a, plunger 62b, return spring 62c, valve-seat 62d, port 62e, and port 62f.

[0046] Cylinder 63a of the control cylinder 63 has port 63e connected to the cut valve 62 and the wheel cylinder 61 at the left end, and can slide the interior now on control piston 63b. Control piston 63b is equipped with seal 63c, and divides the inside of cylinder 63a into the room on either side. The capacity of 63d of rooms connected to the cut valve 62 and the wheel cylinder 61 changes because this control piston 63b slides on right and left. The thrust generated with the thrust generator 64 is told to control piston 63b rod 63f.

[0047] The spring housing 65 consists of spring 65a which has required the pulley load in the state of anchoring, and movable spring-seat 65b.

[0048] The thrust generator 64 generates **** which drives control piston 63b, and compressive force. Electrical-motor 64a will generate torque, if current is passed. Generally, since torque is proportional to the passed current, torque is controllable by controlling current. Pinion 64b tells the torque which electrical-motor 64a generated to gear 64c, and gear 64c tells torque to ball-thread nut 64d. Ball-thread nut 64d, ball-thread shaft 64e and a ball are fitted in, and rotation and the translatory movement are changed mutually. Ball-thread shaft 64e generates the thrust according to the torque added to ball-thread nut 64d, and transmits it to rod 63f. Although ball-thread shaft 64e makes movement possible spline nut 64f and spline tube 64g at right and left, since it is impossible, rotation is established.

[0049] Next, the outline of these operation is explained. Even if control piston 63b is in the center valve position of drawing at the time of un-braking and a brake pedal 40 is stepped on, it protects that control piston 63b retreats by spring 65a which the pulley load required.

[0050] At the time of reduced pressure control, the cut valve 62 is closed, control piston 63b is moved in the direction (right of drawing) which expands the wheel cylinder 61 in cylinder 63a, and the capacity of a side open for free passage, and it decompresses. Through gear 64c and ball-thread nut 64d, movement of this control piston 63b makes control piston 63b generate a thrust, and performs the force of electrical-motor 64a to it.

[0051] On the other hand, at the time of boost control, the cut valve 62 is closed, control piston 63b is moved in the direction (left of drawing) which reduces the capacity in cylinder 63a, and it boosts.

[0052] The relation between wheel-cylinder ** under these control (W/C **) and the current of electrical-motor 64a which is the driving means of control piston 63b becomes like drawing 6 . First, at the time of reduced pressure control, control piston 63b does not move until resultant force with the thrust of control piston 63b and the pressure confined in cylinder 63a overcomes the force of the above-mentioned spring 65a, even if it increases current. And if current increases till the place where this resultant force exceeds the force of spring 65a, spring 65a is pushed, and control piston 63b will contract and will be decompressed.

[0053] On the other hand, at the time of boost control, unless current increases till the place where a piston thrust exceeds the force of charged pressure, control piston 63b does not move. And when current is increased and a thrust exceeds the force of charged pressure, control piston 63b moves and it boosts it. From the relation of this drawing 6 , electrical-motor 64a is ordered the current value corresponding to the desired pressure, and a pressure is controlled. The brake controller 34 controls a brake actuator etc. based on the following flows of control.

[0054] Below, based on the flow chart of drawing 7 - drawing 14 , a brake control flow by the brake controller 34 is explained.

[0055] Drawing 7 is a general flow chart.

[0056] At Step 100, it is asking with reference to all the engine performance maps that the brake controller 34 grade has beforehand, the engine operation point, i.e., engine output torque, which sometimes comes out.

[0057] At Step 200, the amount of brake-pedal treading in, brake-pedal treading-in speed, master cylinder **, etc. were detected, and the operation state of a brake pedal 40 is detected.

[0058] At Step 300, it judges whether vehicles are in a braking state using the detection result of Step 100 and Step 200. If it is judged that it is in a braking state, it will go into the brake control routine after Step 400. If it is judged that it will be in a braking state, it will not go into a brake control routine.

[0059] At Step 400, the target deceleration of vehicles is determined from the brakes operation state detected at the operational status and Step 200 of the engine detected at Step 100. If target deceleration enables it [ the relation of damping force for example, to master cylinder ** becomes equivalent to the conventional brake on a flat way, and ] to obtain the seemingly same damping force as a flat way in consideration of the influence of [ for gravitational acceleration ] on a slope or has a quick brake-pedal treading-in speed, the property of ** that bigger damping force is obtained is given to the same master cylinder **.

[0060] At Step 500, the damping force in the driving wheels 47 and 48 generated by engine brake is calculated.

[0061] At Step 600, in order to realize target deceleration searched for at Step 400, it asks for the driving wheel 47 which can be slowed down in the most stable state, the damping force which the brake actuators 52 and 53 by the side of 48 should generate, and the damping force which the non-driving wheel 45 and the brake actuators 50 and 51 by the side of 46 should generate in consideration of the damping force by circumference [ vehicles ] information, the driving wheel 47, and the engine brake by the side of 48 etc.

[0062] At Step 700, the brake actuators 50-53 currently installed in each wheels 45-48 are driven by making into an instruction value desired value of the driving wheel side brake actuators 52 and 53 for which it asked at Step 600, and the non-driving wheel side brake actuators 50 and 51.

[0063] Next, drawing 8 is used about the engine operation check appearance of Step 100, and it is ** BE ** to a detail more.

[0064] At Step 110, it is asking for the engine speed by measuring the time interval of the pulse signal from the crank angle sensor currently installed in the engine.

[0065] At Step 120, the opening TVO of the throttle valve 2 currently installed in the inlet pipe of an engine is measured.

[0066] At Step 130, it is asking for the engine output torque at all the engine performance maps beforehand memorized by the brake controller 34 grade as shown in drawing 3 to that time from the obtained engine speed and TVO.

[0067] Next, brake-pedal-application state detection of Step 200 is explained in more detail, referring to drawing 9 .

[0068] At Step 210, the signal from the stroke sensor 44 currently installed in the brake pedal 40 was read, and the amount of brake-pedal treading in is detected.

[0069] At Step 220, brake-pedal treading-in speed is detected from a time change of the amount of brake-pedal treading in.

[0070] Master cylinder ** is detected at Step 230.

[0071] Next, the braking state judgment routine of Step 300 is explained in more detail, referring to drawing 10 .

[0072] At Step 310, it investigates whether the engine output torque for which it asked at Step 100 is positive, or it is negative. If it is positive, it will progress to Step 320. If it is negative, it will be judged that it is in a braking state.

[0073] It judges whether the brake pedal 40 is stepped on from the amount of brake-pedal treading in calculated at Step 200, and at Step 320, if it steps on and is in a braking state, it judges, and if it does not step on, it will judge with it being in a braking state.

[0074] Next, it explains, referring to drawing 11 about the routine which computes the damping force by the engine brake in the driving wheels 47 and 48 in Step 500.

[0075] At Step 510, the engine output torque for which it asked at Step 100 is read.

[0076] At Step 520, it judges whether the lock-up clutch of a torque converter is on, or it is off. In on, it progresses to Step 540. In off, it progresses to Step 530.

[0077] At Step 530, from input rotation and output rotation of a torque converter, it asks for a velocity ratio, and with reference to the torque converter performance curve which is shown in drawing 4 and which the brake controller 34 grade has memorized beforehand, it asks for a torque ratio and asks for a torque converter output torque.

[0078] At Step 540, a change gear output torque is calculated from the change gear ratio of the torque converter output torque (in the case of the lock-up clutch on, it is the torque converter output-torque = engine output torque) and change gear 33 for which it asked previously.

[0079] At Step 550, the torque in a drive shaft is searched for from the last reduction gear ratio which is clear beforehand.

[0080] At Step 560, it asks for the damping force by the engine brake in driving wheels 47 and 48 from the tire radius which is clear beforehand, and the drive shaft torque searched for previously.

[0081] Next, the detail of Step 600 is explained using drawing 12 .

[0082] At Step 610, the target deceleration determined at Step 400 is read.

[0083] At Step 620, it is judged whether it is in a flight hill and a downward slope whether self-vehicles are in a flat way to be the vehicles current position obtained by the navigation system 35 from the traffic information currently beforehand recorded on the storage of a navigation system 35, for example.

[0084] At Step 630, required damping force is computed from traffic informations, such as a vehicles order weight distribution, target deceleration, and a road grade for which it asked at Step 620. Although the ratio of the weight of an anterior and the weight of a posterior which were memorized beforehand is used for a vehicles order weight distribution, for example, it measures the number of crews (for example, you may make it the system into which a driver can input the number beforehand), determines the per capita weight beforehand, and is good as for a method of an amendment in the weight distribution.

[0085] At Step 640, it asks for a front wheel 45, the damping force which should be generated in 46 sides, and a rear wheel 47 and the damping force which should be generated in 48 sides from a vehicles order weight distribution, target deceleration, the traffic information searched for at Step 620 so that four flowers can brake with equal slip ratio.

[0086] At Step 650, the driving wheel side damping force reduced property of the engine brake for which it asked at Step 500 is read.

[0087] It asks for the required damping force by the side of a driving wheel 47 and 48 at Step 660. If it is a rear drive vehicle, let the value which lengthened the driving wheel side damping force reduced property of the engine brake read at Step 650 from the damping force which the rear wheel side for which it asked at Step 640 should generate be the required damping force by the side of a driving wheel 47 and 48.

[0088] In addition, in this case, if it is a front drive vehicle, let the value which lengthened the driving wheel side damping force reduced property of the engine brake read at Step 650 from the damping force which the front-wheel side for which it asked at Step 640 should generate be the required damping force by the side of a driving wheel.

[0089] And it asks for the target brake actuator fluid pressure for generating this damping force.

[0090] At Step 670, it asks for the required damping force by the side of the non-driving wheel 45 and 46 similarly. If it is a rear drive vehicle, the damping force which the front-wheel side for which it asked at Step 640 should generate will serve as the value.

[0091] In addition, in this case, if it is a front drive vehicle, the damping force which the rear wheel side for which it asked at Step 640 should generate will serve as the value.

[0092] It asks for the target brake actuator fluid pressure for generating the damping force.

[0093] Next, drawing 13 is explained to reference in detail about brake control of Step 700.

[0094] This controls electrical-motor 64a which each brake actuators 50-53 have, the driving wheel side for which it asked at Step 600, and in order to realize a non-driving wheel side target brake bitter taste CHUE 1 TA fluid-pressure value. Although nothing will be carried out if the pressure and instruction value which have been generated with the master cylinder 42 are specifically equal, if the pressure and instruction value which have been generated with the master cylinder 42 are not equal, it is closing the cut valve 62 and carrying out current control of the electrical-motor 64a, and a pressure is controlled to obtain a target brake bitter taste CHUE 1 TA fluid pressure, respectively.

[0095] Here, the traffic information in the above-mentioned steps 620-640 and the desired value determination of damping force based on a vehicles weight distribution are explained in more detail using drawing 14 .

[0096] At Step 810, the LAT and LONG which shows the current position of vehicles are detected using a navigation system 35. Things which have 3-dimensional geographical feature data, such as what has altitude data of the point for every fixed distance interval of a certain in the shape of a mesh, are used for the navigation system 35 used here.

[0097] At Step 820, four points of the above-mentioned mesh containing the current position of vehicles are detected, and each altitude data is read.

[0098] At Step 830, the altitude of the current position of vehicles is calculated by interpolating the altitude data of the four above-mentioned points. As the calculation method, the following methods are mentioned, for example.

[0099] Four points of the above-mentioned mesh are set to A, B, C, and D, and suppose that A points and the B point are in the north side like drawing 15 . Here, the altitude of M points is first calculated-like proportionally from the LONG information on A points and the B point, and the LONG information on the vehicles current position. The altitude of N point ** is similarly calculated-like proportionally from the LONG information on C points and D points, and the LONG information on the vehicles current position. Finally the altitude of the vehicles current position is proportionally computed-like from the LAT information on M points and N points, and the LAT information on the vehicles current position.

[0100] At Step 840, the position through which vehicles will pass in the near future (for example, after several seconds) is predicted. As the concrete method of prediction, a map picture is treated in image processing and the method of following a passage and going is mentioned, for example.

[0101] First, it asks for the travelling direction of vehicles from the situation of movement of the past of vehicles. Next, the pixel which carries out the scan of the pixel on the map picture which is in a short fixed distance to travelling direction on the basis of the current position of vehicles to right and left circularly, and shows a passage is looked for. This discovered pixel becomes the position presumed that vehicles pass in the near future. Next, the discovered point is also taken into consideration, it reasks for the travelling direction of the vehicles in the future for a while, and the same

procedure is repeated. And it is carrying out number-of-times (this number of's times being set up in quest of the point in which asks for the fixed number-of-times:regularity distance remote point, or number-of-times:fixed time after vehicles according to the vehicle speed are etc.) operation of predetermined, and the prediction position where vehicles probably exist after the predetermined time is called for.
[0102] Four mesh which will include a position in the future [ vehicles ] are searched with Step 850 like Step 820, and the advanced data is read.
[0103] At Step 860, the altitude of a position will be computed by the same method as Step 830 in the future [ vehicles ].
[0104] It asks for the road grade of the altitude of the vehicles current position for which it asked at Step 830, the advanced shell of a vehicles future position for which it asked at Step 860, and vehicles travelling direction at Step 870.
[0105] in addition, this road grade -- the target deceleration of the vehicles in Step 400 -- an amendment -- you may make it like
[0106] At Step 880, it asks for the weight distribution of a vehicles order ring by calculation from the road grade for which it asked at Step 870.
[0107] That is, on a flight hill, a load moves to rear wheel 47 and 48 side, and a load moves to front-wheel 45 and 46 side on a downward slope. When the relation is expressed with a formula, and vehicles are level, between the front-wheel side load F1 and the rear wheel side load F2, it is F1:F2=L2:L1. -- (5)
F=F1+F2 -- (6)
However, distance L2 from the F:gross-vehicle-weight L1:vehicles center of gravity to the load line of action of a front wheel: There is a relation of the distance from the vehicles center of gravity to the load line of action of a rear wheel.
[0108] On the other hand, it is F1:F2=L4:L3, using center-of-gravity quantity as h, when vehicles have a skew ratio in the flight hill of theta like drawing 16 . -- (7)
L3=L1+h-tantheta -- (8)
L4=L2-h-tantheta -- (9)
F=F1+F2 -- (10)
However, distance L4 from the F:gross-vehicle-weight L3:vehicles center of gravity to the load line of action of a front wheel: The front-wheel side load F1 and the rear wheel side load F2 are given in the distance from the vehicles center of gravity to the load line of action of a rear wheel.
[0109] From such relational expression, it can ask for a front wheel 45, the perpendicular reaction f1 and the rear wheel 47 to the slant face by the side of 46, and the perpendicular reaction f2 to the slant face by the side of 48 as follows (it is the same also about a downward slope). [0110]
f1= [(L2-h-tantheta )/(L1+L2)] -F-costheta -- (11)
f2= [(L1+h-tantheta )/(L1+L2)] -F-costheta -- (12)
By therefore, the thing which the amount of [ by the side of a driving wheel ] engine brake also makes generate in consideration of the front-wheel side brake force proportional to each of such front-wheel side perpendicular reaction f1 and the rear wheel side perpendicular reaction f2, and a rear wheel side brake force In the relation of the slip ratio and the road surface which show the relation of the frictional force of a tire and a road surface, it becomes possible to slow down and stop vehicles, always being able to generate damping force in the same slip ratio with all wheels, and always having the greatest margin to a wheel lock, even if the skew ratio of a passage changes.
[0111] Thus, since it considered as the composition which controls brake bitter taste CHUE 1 TA 50-53 so that the road grade in connection with the operational status of vehicles, a vehicles weight distribution, and the damping force by the engine brake by the side of a driving wheel might also be taken into consideration and the burden of each tire might become equal independently about four flowers, the braking performance in which vehicles always slow down simultaneously have vehicles in the state where it was stabilized is demonstrated to the maximum extent.
[0112] Moreover, by not making it the usual brake and double composition, since ** is also good, structure simplifies and cost decreases.
[0113] Drawing 17 shows the gestalt of the 2nd operation, and it controls the damping force by engine brake while it adds a weather state and determines the desired value of damping force.
[0114] In this case, it is made the composition that a driver chooses from some alternative (for example, being fine rain, snow, etc.), and carries out a switch input as simplest means as a weather state detection means.
[0115] Moreover, composition which is referred to as presuming the weather from the operating state of a wiper, atmospheric temperature, etc. in addition to this may be used. In this case, what is necessary is just to make the judgment of ** that it is very easy to slide on a road surface since the road surface may have frozen, if the atmospheric temperature on which it is snowing if the wiper on which a road surface tends to slide somewhat since it is raining if the wiper is operating is operating and atmospheric temperature is the freezing point, and a road surface tends [ very ] to

slide is the freezing point.

[0116] And when it is judged that it is in the state of being easy to slide on a road surface by the weather state detection means, the damping force by the side of the driving wheel 47 by engine brake and 48 (in the case of a rear drive vehicle) is weakened by making the change gear ratio of a change gear 33 change gears to the Hi side, change of the vehicles behavior by engine brake is suppressed, and almost equivalent damping force is generated in non-driving wheel 45 and 46 side with the brake actuators 50 and 51. Of course, what has that possible this braking performs antilock control like ABS (anti-lock brake system) is used.

[0117] Therefore, it slows down in the state where avoided behavior unstable [ of vehicles ] by [ which make it the minimum for what a wheel locks since it was easy to slide on a road surface and target damping force was too large to be avoidable, and to generate behavior with unstable vehicles ] performing antilock control though things can be carried out and a wheel locks, and it was stabilized, and things can be carried out.

[0118] If a control flow is explained based on drawing 17 , it is asking for the road grade ahead of the travelling direction to the current position of vehicles at Step 1010.

[0119] At Step 1020, the road grade for which it asked at Step 1010 was also taken into consideration, and has determined the braking-force-distribution ratio of driving wheels 47 and 48 and the non-driving wheels 45 and 46.

[0120] At Step 1030, the damping force by the engine brake at that time is calculated.

[0121] Steps 1010-1030 are the same as a precedent.

[0122] At Step 1040, the weather has distinguished whether it is fine by the weather state detection means. If it is fine, it progresses to Step 1050, it is fine, and if it does not come out, it will progress to Step 1060.

[0123] At Step 1060, it has distinguished whether the weather rains or not by the weather state detection means. rain -- be -- it progresses to ** and Step 1070, and if it does not rain (snow or road surface freeze), it will progress to Step 1080

[0124] At Step 1070, road surface coefficient of friction to which it is beforehand set in the case of having wetted wet in the case of rain (i.e., a road surface) is read.

[0125] At Step 1080, road surface coefficient of friction supposing the case where it may be frozen in snow or the road surface freeze (i.e., a road surface), and is easy to slide set up beforehand is read.

[0126] At Step 1090, a driving wheel 47 and the maximum damping force which can be generated in 48 sides are calculated from the maximum coefficient of friction according to the weather state called for at Step 1070 or Step 1080, and a vehicles weight distribution.

[0127] Step 1100 is comparing the damping force by the engine brake for which it asked at Step 1030, the weather state searched for at Step 1090, the driving wheel 47 in consideration of the vehicles weight distribution, and the maximum damping force by the side of 48 which can be generated. If the damping force by engine brake is smaller, it will progress to Step 1050. If the damping force by engine brake is larger, it will progress to Step 1110.

[0128] It asks for the change gear ratio of the change gear 33 with which the damping force by engine brake becomes a value only with a predetermined value (or predetermined rate) smaller than the maximum damping force which can be generated at Step 1110. This uses all the engine performance maps shown in drawing 3 . [0129] At Step 1120, the change gear ratio for which it asked at Step 1110 is changed as a target change gear ratio of the change gear controller 37. This weakens the damping force by engine brake.

[0130] When it progresses to Step 1050 from Step 1040 or Step 1100, in consideration of the damping force by the engine brake at that time, a braking force control as the precedent explained is performed.

[0131] When it progresses to Step 1050 from Step 1120, in consideration of the damping force by the engine brake changed according to the weather state, a braking force control as the precedent explained is performed. In this case, damping force almost equivalent to the damping force by the engine brake before change is made generated by giving damping force with the non-driving wheel 45 and the brake actuators 50 and 51 by the side of 46.

[0132] Hereafter, the gestalt of the 3rd - the 6th operation is described.

[0133] The gestalt of the 3rd operation changes the Bure Hajime KI force the optimal to change of the weight distribution of the vehicles according to the number of fellow passengers.

[0134] In this case, it is made the composition which a driver inputs as the number of fellow passengers as the method of detection of change of the weight distribution by it using the interface established around the driver's seat. For example, if it inputs into each sheet whether people are sitting down, weight-distribution estimate will be calculated by, for example, assuming the weight beforehand determined as 55 etc.kg per one person etc. Furthermore, if it enables it to input into a trunk whether there is any load, the precision of a weight distribution will also go up further.

[0135] And if the braking force control of a precedent is performed based on the weight distribution by this, more suitable damping force will be obtained.

[0136] The gestalt of the 4th operation measures the weight distribution of vehicles directly, and installs a stroke sensor in the spring section of the suspension of a front wheel and a rear wheel.

[0137] Thereby, since all of road-grade change, the difference in the entrainment number, the effect of acceleration and deceleration, etc. appear as change of a stroke, direct load change can be read in change of the amount of shrinkages and spring constant of a spring. However, it is indispensable to remove the stroke change by the irregularity of a road surface by the low pass filter.

[0138] Without asking for a road grade etc., if it does in this way, a suitable braking force control can be performed and much more exact damping force is obtained.

[0139] In addition, when measuring only the weight distribution of vehicles, you may measure at the time of the vehicle speed 0 (at the time of a halt).

[0140] The gestalt of the 5th operation simplifies structure and control. It is made the composition which brakes by carrying out a brake actuator [ right-and-left ] by the front-wheel side and rear wheel side or it controls individually the brake actuator which determined desired value respectively common to right and left in this example at a front-wheel side and rear wheel side although the brake actuator which determined the control-objectives value for every wheel altogether in aforementioned each example, and was installed for every wheel was controlled individually, and was installed in each wheel.

[0141] The gestalt of the 6th operation is applied to motorised vehicles (electric vehicle). In each aforementioned example, altogether, as a prime mover, although the example which used the engine is shown, this is changed into a motor, namely, same control is performed for the amount of engine brake as an amount of regeneration of the electrical energy of a motor.

[0142] In this case, are the situation of wanting to make [ many / as possible ] recovery of the energy by regeneration, and are easy to slide on a road surface, and it sets in a situation which a wheel locks only by the regenerative brake. By enlarging instruction torque (since it being at the regeneration time negative value) to a motor, and adjusting a regenerative brake from comparison of wheel speed and car body speed, like ABS (anti-lock brake system), if wheel speed falls It can also perform securing the biggest possible amount of regeneration, acquiring the same effect as ABS.

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[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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## DRAWINGS

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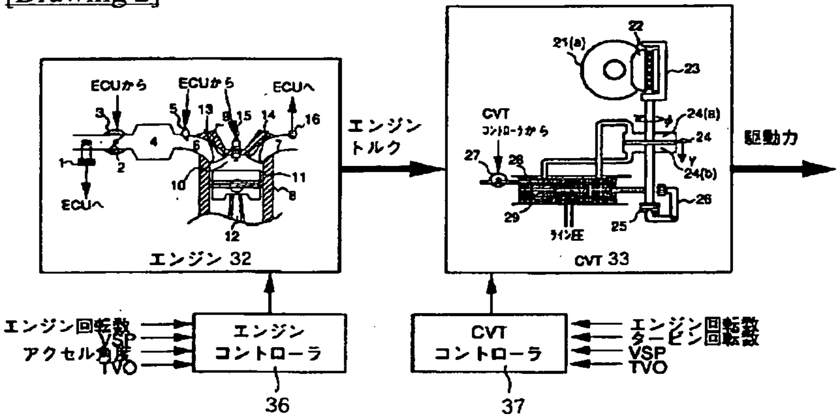
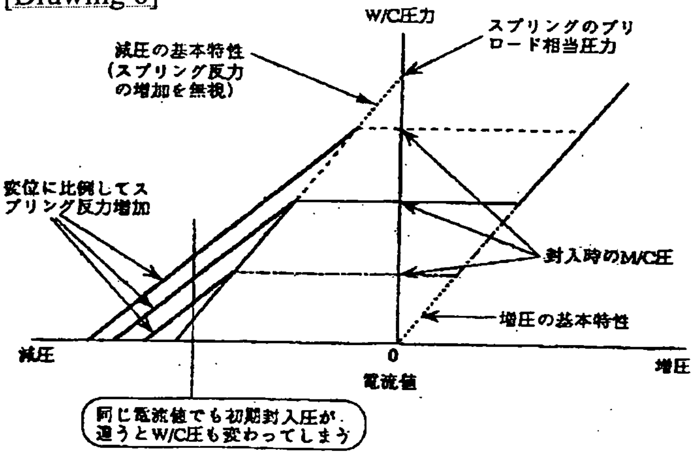
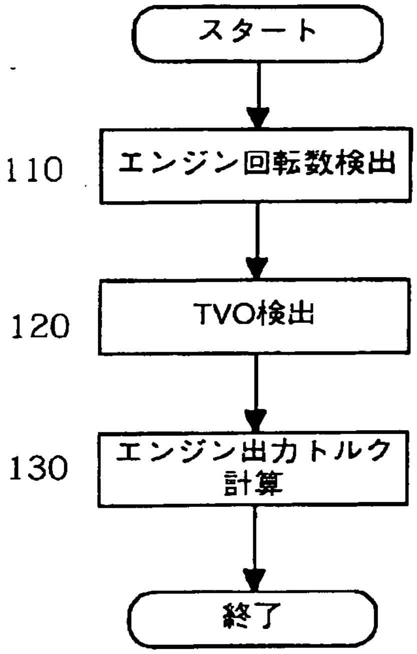
[Drawing 2]


ECUから
ECUから
ECUへ
ECUへ
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
エンジン 32
エンジントルク
21(a)
22
23
24(a)
24
24(b)
25
26
27
28
29
CVT コントローラから
ライン圧
CVT 33
駆動力
エンジン回転数
VSP
アクセル角度
TVO
エンジン コントローラ
36
CVT コントローラ
37
エンジン回転数
タービン回転数
VSP
TVO

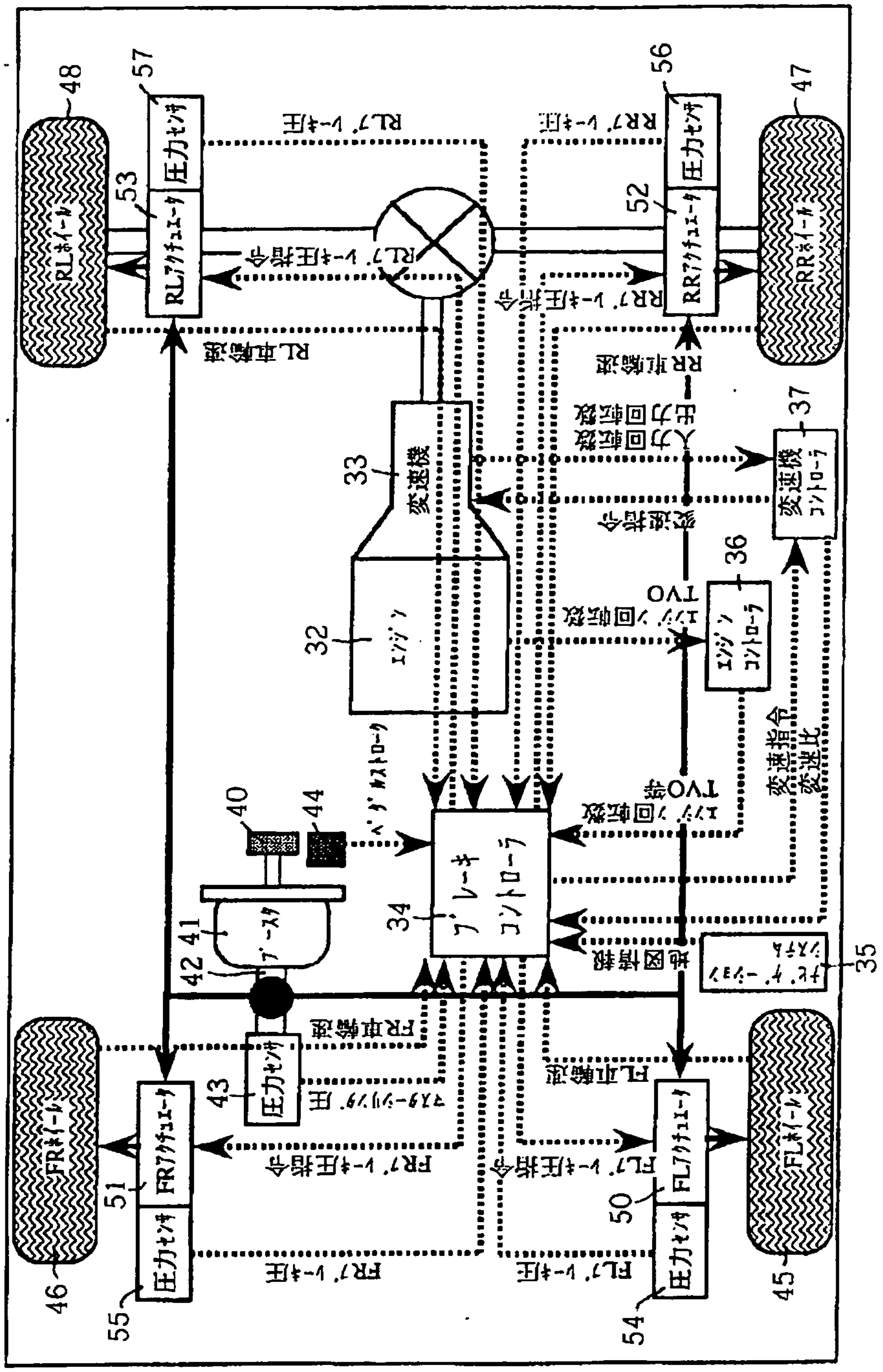
[Drawing 6]



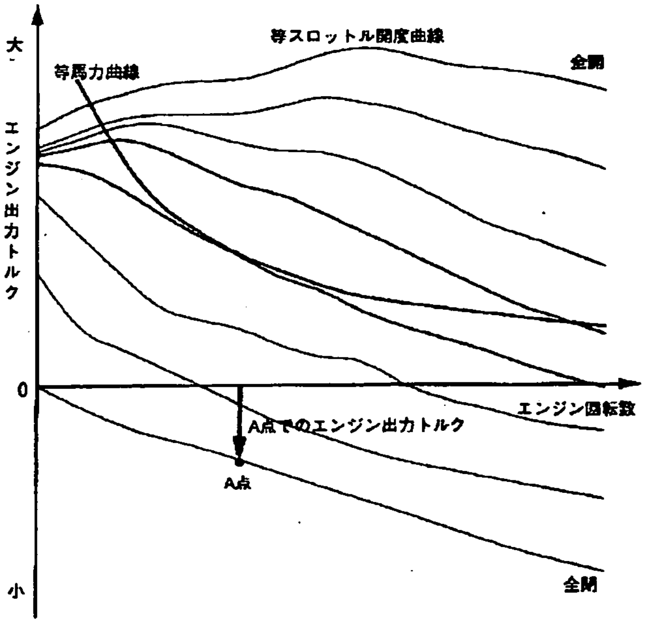
[Drawing 8]


スタート
110
エンジン回転数検出
120
TVO検出
130
エンジン出力トルク計算
終了

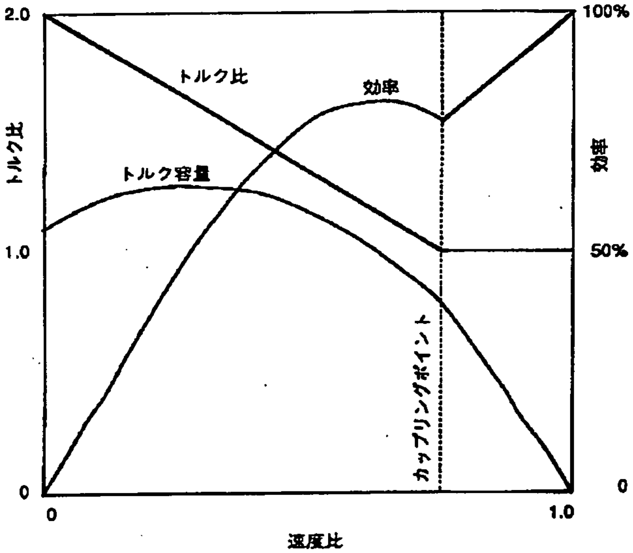
[Drawing 1]


48
57
53
RLホイール
RLアクチュエータ
圧力センサ
RLブレーキ圧
RLブレーキ圧指令
RL車輪速
56
47
52
RRアクチュエータ
圧力センサ
RRホイール
RRブレーキ圧
RRブレーキ圧指令
RR車輪速
33
変速機
出力回転数
入力回転数
変速指令
37
変速機コントローラ
32
エンジン
36
エンジンコントローラ
エンジン回転数
TVO
変速指令
変速比
TVO等
40
44
ペダルストローク
34
ブレーキコントローラ
41
ブースタ
42
地図情報
35
ナビゲーションシステム
FR車輪速
43
圧力センサ
マスターシリンダ圧
FRアクチュエータ
FRブレーキ圧指令
51
FRホイール
55
46
圧力センサ
FRブレーキ圧
FL車輪速
FLアクチュエータ
FLブレーキ圧指令
50
FLホイール
45
54
圧力センサ
FLブレーキ圧

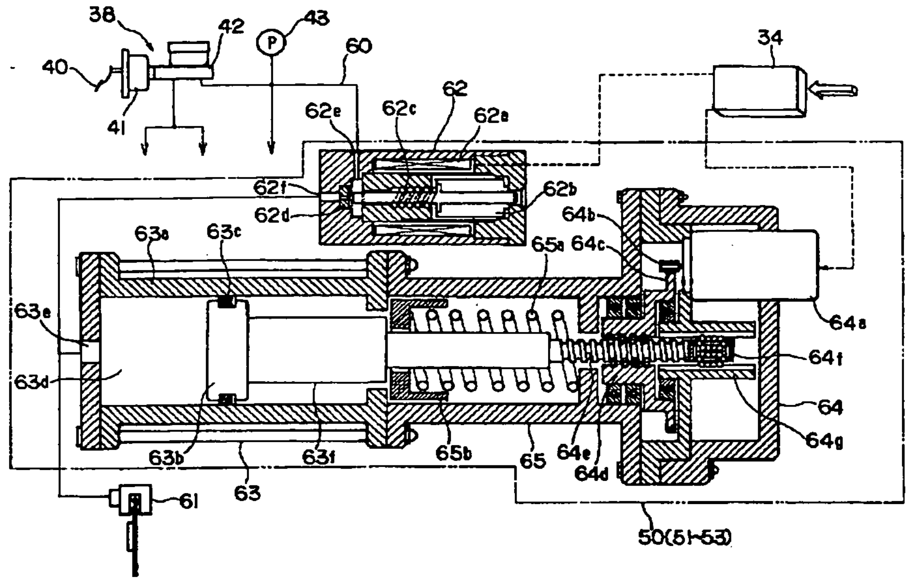
[Drawing 3]



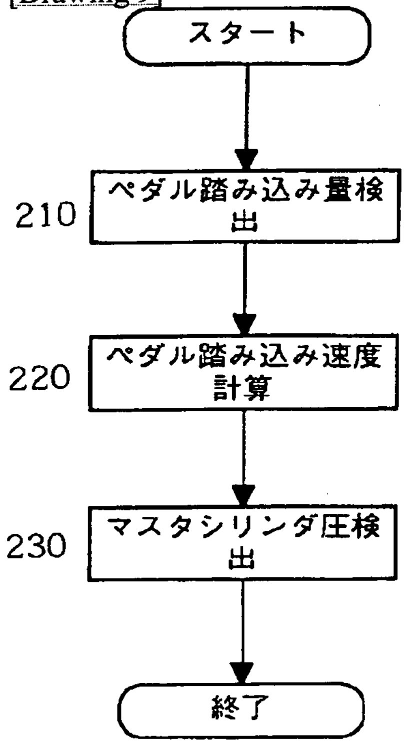
[Drawing 4]



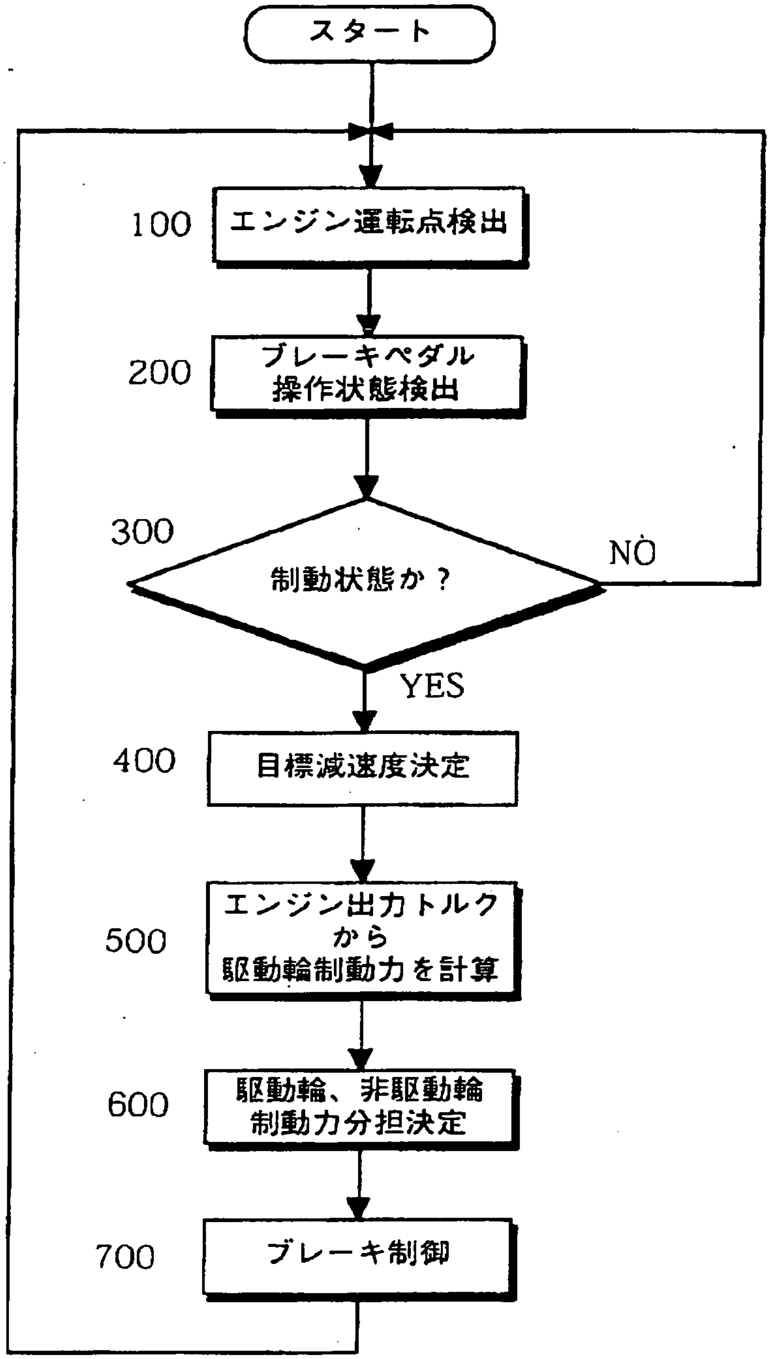
[Drawing 5]


38
42
43
P
40
60
41
34
62
62a
62c
62e
62f
62d
62b
64b
64c
65a
63a
63c
63e
63d
64a
64f
64
64g
63b
63f
65b
65
64e
64d
63
61
50(51~53)

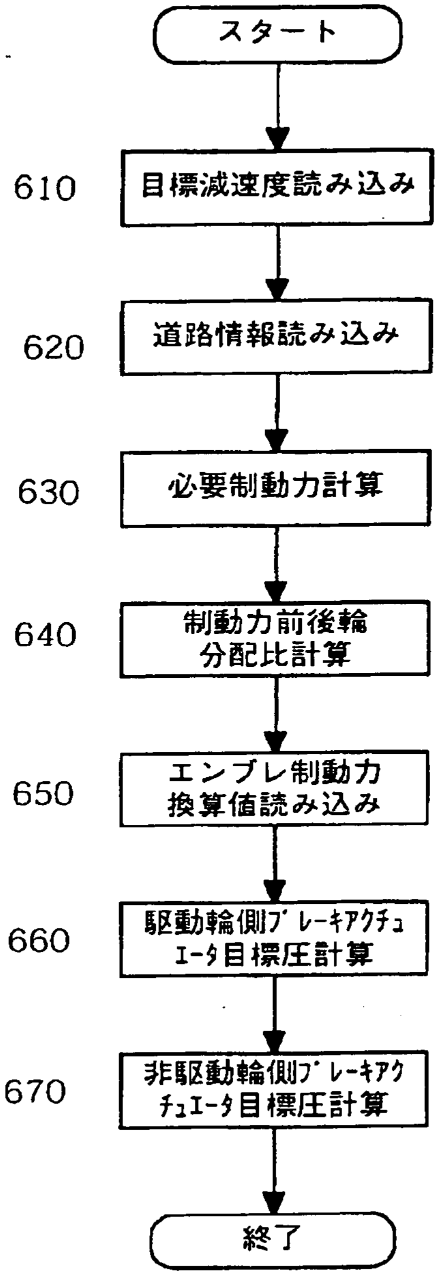
[Drawing 9]


スタート
210
ペダル踏み込み量検出
220
ペダル踏み込み速度計算
230
マスタシリンダ圧検出
終了

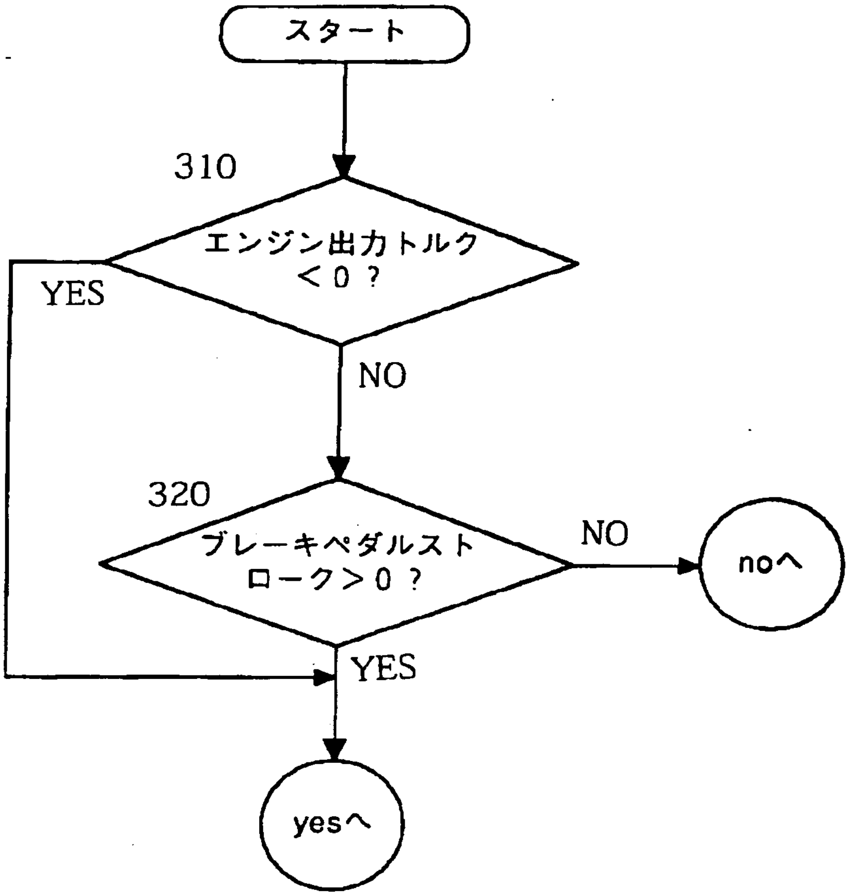
[Drawing 7]


スタート
100
エンジン運転点検出
200
ブレーキペダル
操作状態検出
300
制動状態か？
NO
YES
400
目標減速度決定
500
エンジン出力トルク
から
駆動輪制動力を計算
600
駆動輪、非駆動輪
制動力分担決定
700
ブレーキ制御

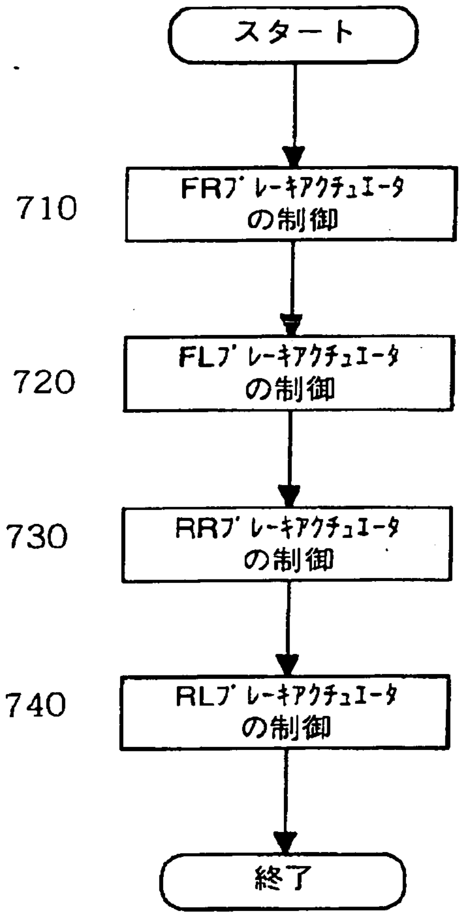
[Drawing 12]


スタート
610
目標減速度読み込み
620
道路情報読み込み
630
必要制動力計算
640
制動力前後輪
分配比計算
650
エンブレ制動力
換算値読み込み
660
駆動輪側ﾌﾞﾚｰｷｱｸﾁｭ
ｴｰﾀ目標圧計算
670
非駆動輪側ﾌﾞﾚｰｷｱｸ
ﾁｭｴｰﾀ目標圧計算
終了

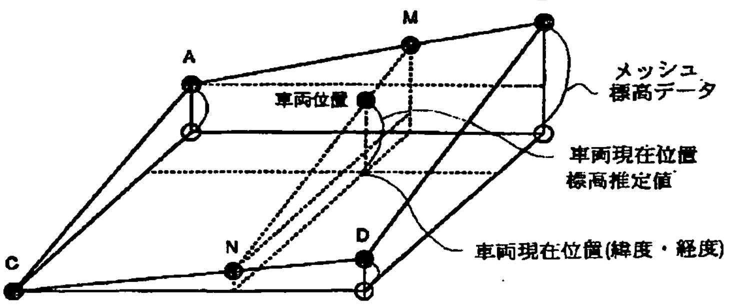
[Drawing 10]


スタート
310
エンジン出力トルク
＜０？
YES
NO
320
ブレーキペダルスト
ローク＞０？
NO
no へ
YES
yes へ

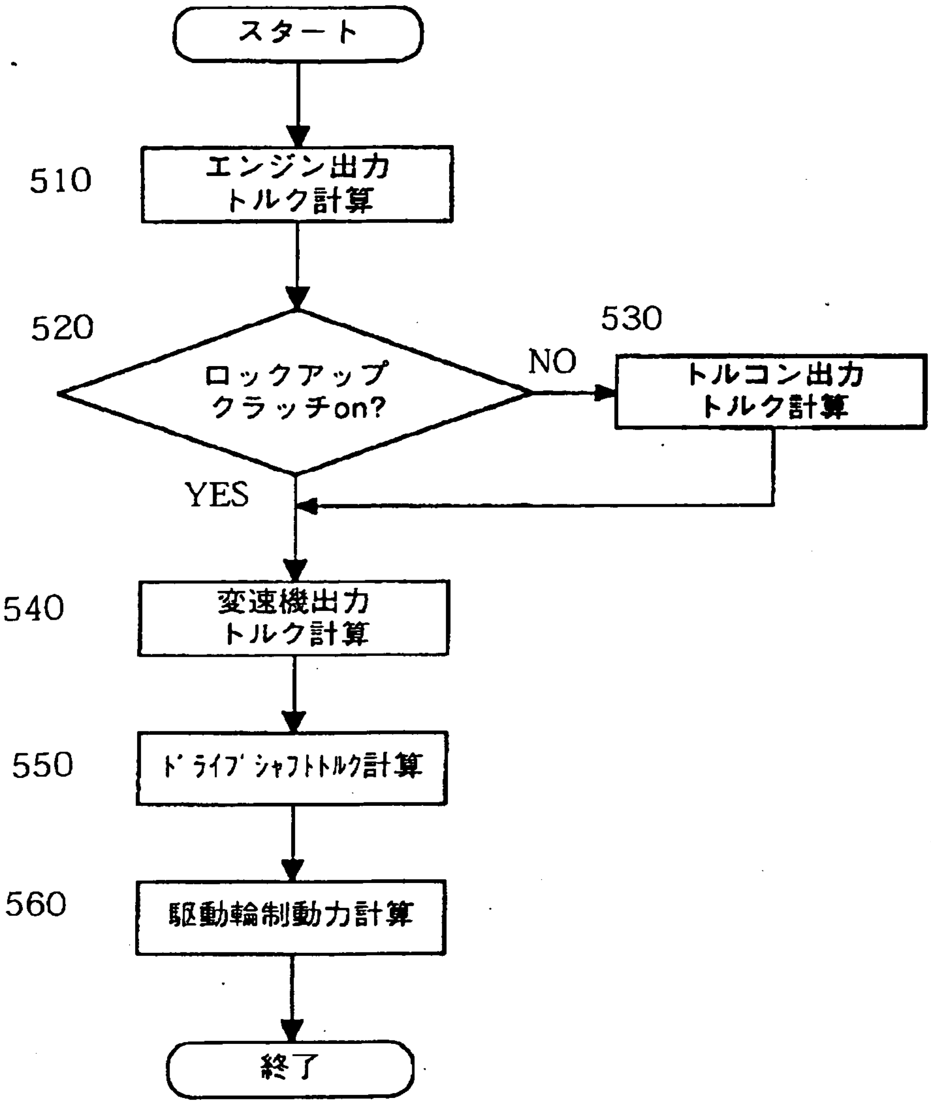
[Drawing 13]


スタート
710
FRブレーキアクチュエータの制御
720
FLブレーキアクチュエータの制御
730
RRブレーキアクチュエータの制御
740
RLブレーキアクチュエータの制御
終了

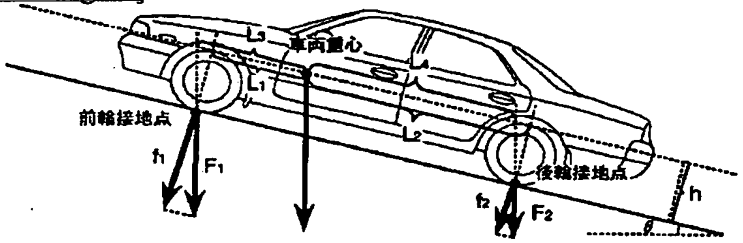
[Drawing 15]


A
M
B
C
N
D
車両位置
メッシュ標高データ
車両現在位置標高推定値
車両現在位置(緯度・経度)

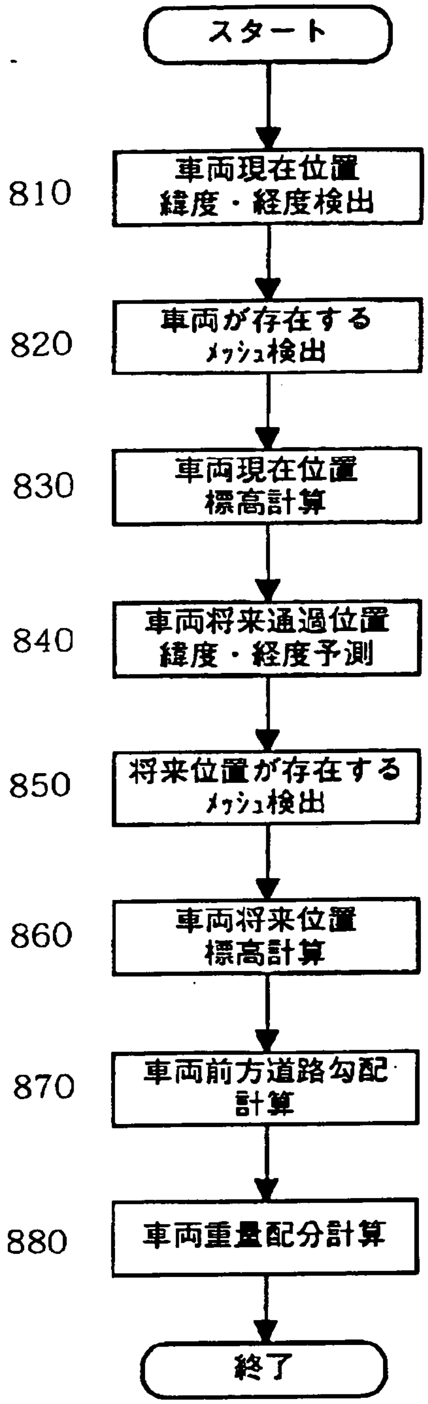
[Drawing 11]


スタート
510
エンジン出力
トルク計算
520
ロックアップ
クラッチon?
NO
530
トルコン出力
トルク計算
YES
540
変速機出力
トルク計算
550
ドライブシャフトトルク計算
560
駆動輪制動力計算
終了

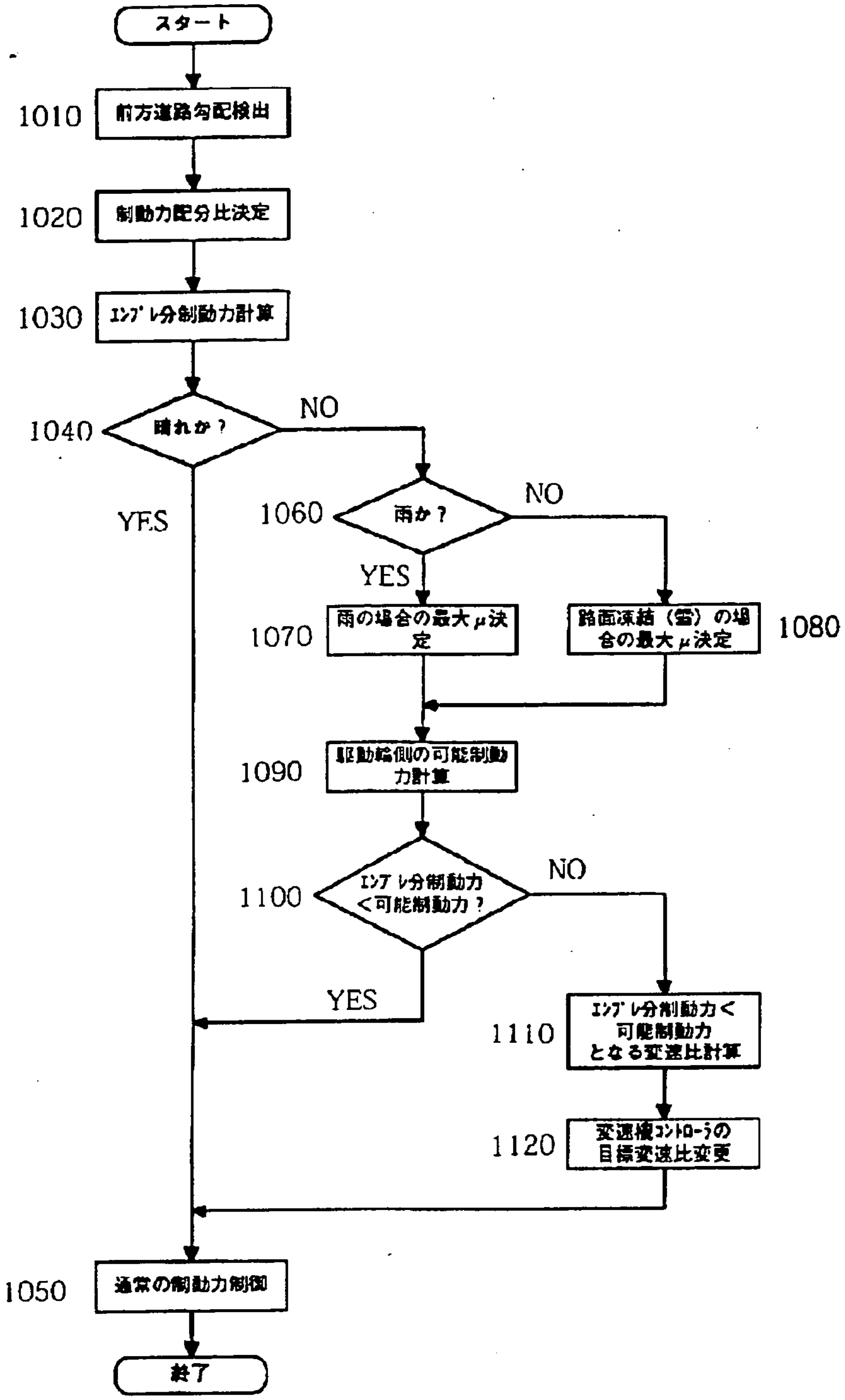
[Drawing 16]


L3
車両重心
L4
L1
前輪接地点
L2
f1
F1
後輪接地点
h
f2
F2
θ

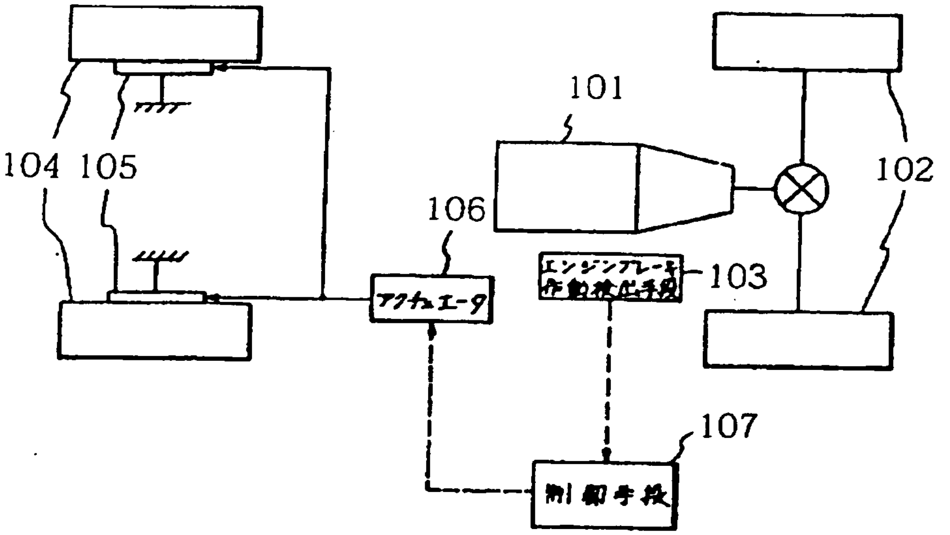
[Drawing 14]


スタート
810
車両現在位置
緯度・経度検出
820
車両が存在する
ﾒｯｼｭ検出
830
車両現在位置
標高計算
840
車両将来通過位置
緯度・経度予測
850
将来位置が存在する
ﾒｯｼｭ検出
860
車両将来位置
標高計算
870
車両前方道路勾配
計算
880
車両重量配分計算
終了

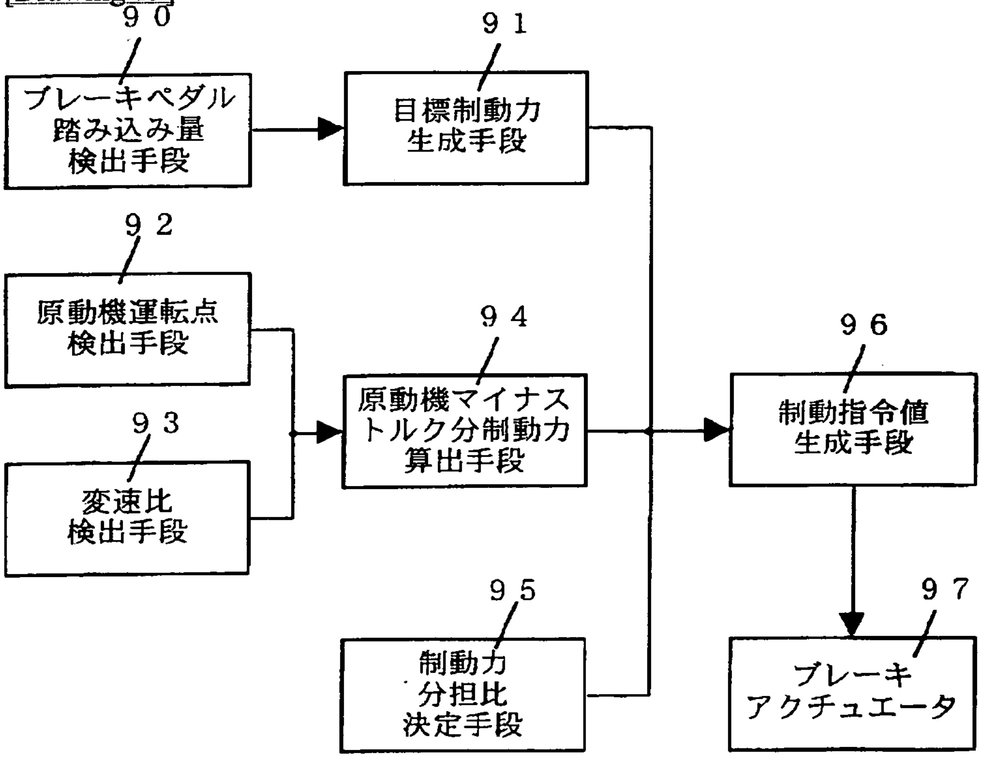
[Drawing 17]


スタート
1010
前方道路勾配検出
1020
制動力配分比決定
1030
ｴﾝﾌﾞﾚ分制動力計算
1040
晴れか？
NO
YES
1060
雨か？
NO
YES
1070
雨の場合の最大μ決定
1080
路面凍結（雪）の場合の最大μ決定
1090
駆動輪側の可能制動力計算
1100
ｴﾝﾌﾞﾚ分制動力＜可能制動力？
NO
YES
1110
ｴﾝﾌﾞﾚ分制動力＜可能制動力となる変速比計算
1120
変速機ｺﾝﾄﾛｰﾗの目標変速比変更
1050
通常の制動力制御
終了

[Drawing 18]


101
102
103
104
105
106
107
アクチュエータ
エンジンブレーキ作動検出手段
制御手段

[Drawing 19]


90
ブレーキペダル踏み込み量検出手段
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目標制動力生成手段
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原動機運転点検出手段
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[Translation done.]